Hole's Human Anatomy and Physiology

Twelfth Edition

Shier ◆ Butler ◆ Lewis

Chapter 7 Skeletal System

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7.1: Introduction

Human skeleton initially cartilages and fibrous membranes

- Hyaline cartilage is the most abundant cartilage
- By age 25 the skeleton is completely hardened growth ceases
- 206 bones make up the adult skeleton (20% of body mass)
    - 80 bones of the axial skeleton
    - 126 bones of the appendicular skeleton

7.2: Bone Structure

- Bones of the skeletal system vary greatly in size and shape

- There is similarity in structure, development, and function

Support, Protection, and Movement

- Support, Movement & Protection
  - Gives shape to head, etc.
  - Supports body's weight
  - Protects lungs, etc.
  - Bones and muscles interact
  - When limbs or body parts move

Bone Classification

- Bone Classification:
  - Long Bones
  - Short Bones
    - Sesamoid Bones
  - Flat Bones
  - Irregular Bones

  - Wormian Bones

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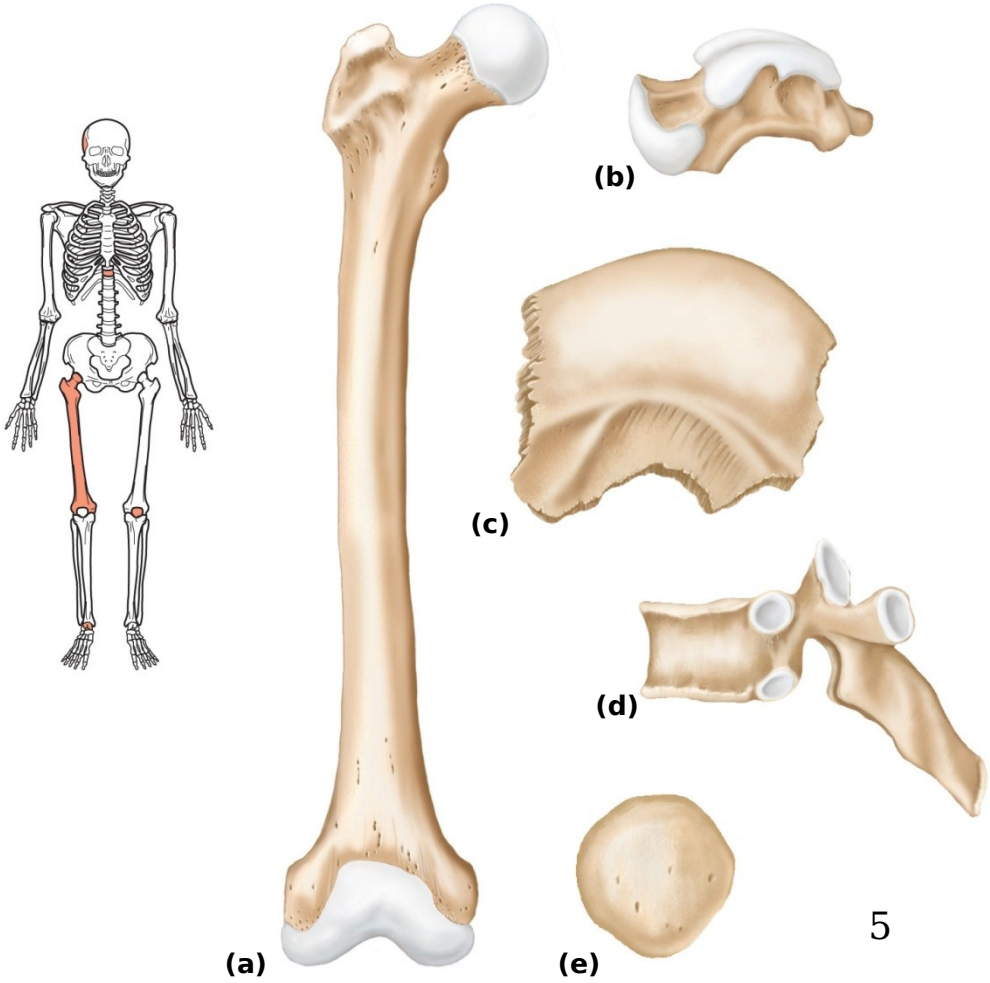

Parts of a Long Bone

- Epiphysis
  - Distal
  - Proximal
- Diaphysis
- Metaphysis
- Compact bone
- Spongy bone
- Articular cartilage
- Periosteum
- Endosteum
- Medullary cavity
- Trabeculae
- Bone marrow
  - Red marrow and yellow marrow

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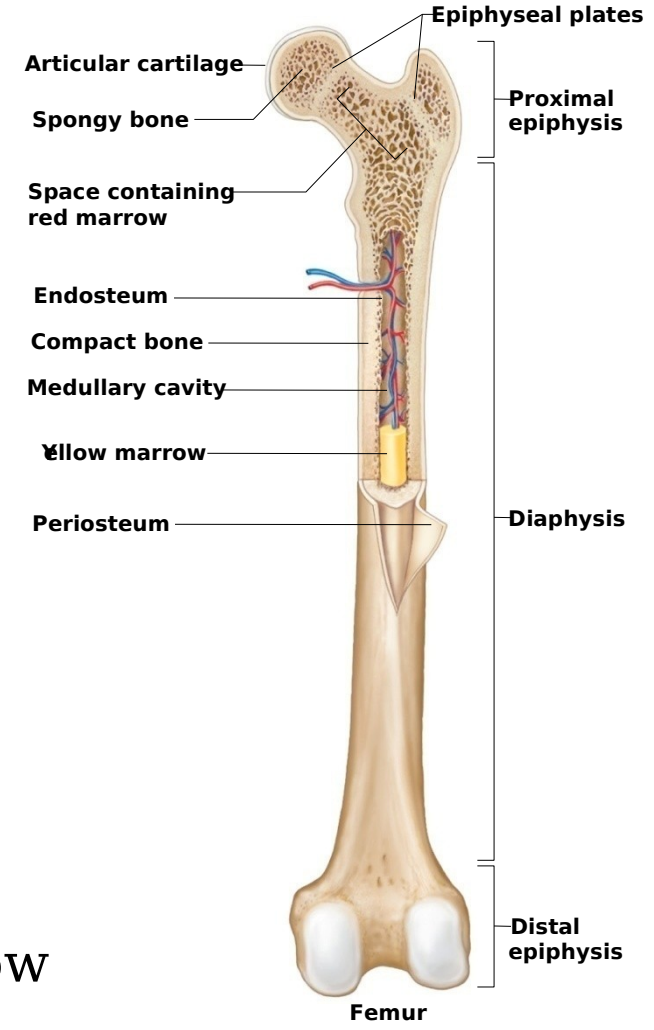

Microscopic Structure

- Bone cells are called osteocytes
- Osteocytes transport nutrients and wastes
- The extracellular matrix of bone is largely collagen and inorganic salts
  - Collagen gives bone resilience
  - Inorganic salts make bone hard

Compact Bone

- Osteon
aka Haversian System
- Central canal
- Perforating canal
aka Volkmann's canal
- Osteocytes
- Lamellae
- Lacunae
- Bone matrix
- Canaliculi

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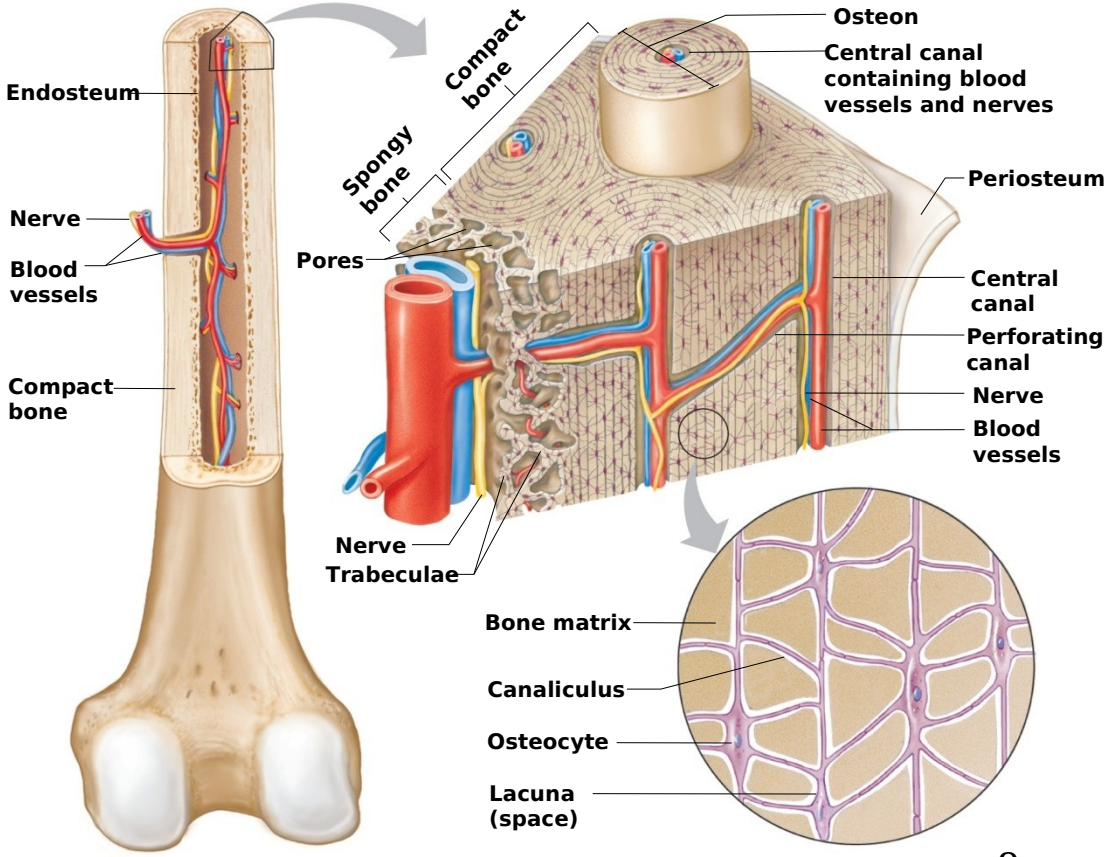

Spongy Bone

- Spongy bone is aka cancellous bone

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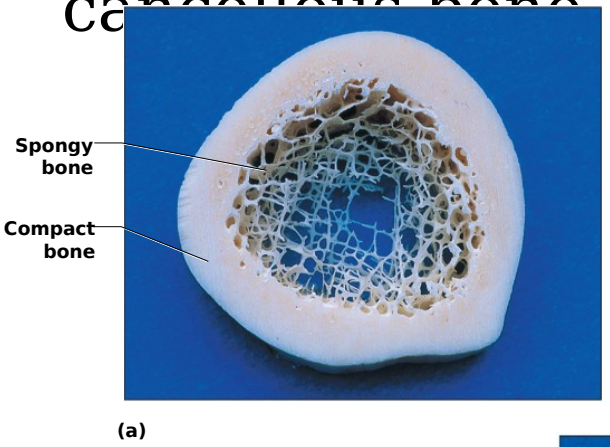

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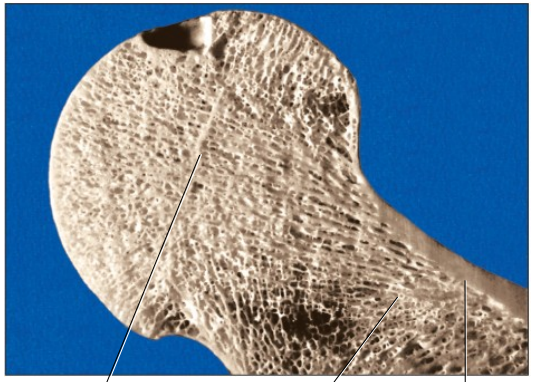

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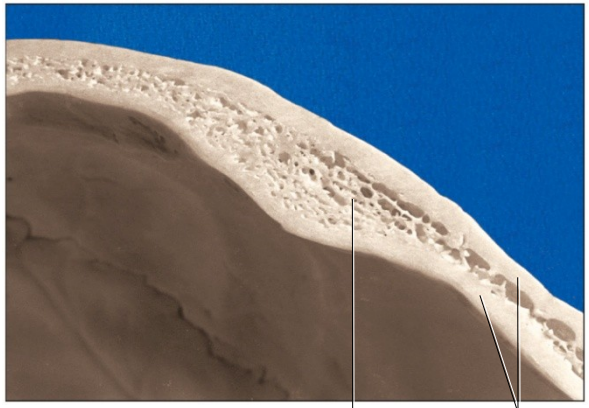

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7.3: Bone Development and Growth

- Parts of the skeletal system begin to develop during the first few weeks of prenatal development

- Bones replace existing connective tissue in one of two ways:
  - As intramembranous bones
  - As endchondral bones

Intramembranous Bones

- Intramembranous Bones
  - These bones originate within sheetlike layers of connective tissues
  - They are the broad, flat bones
    - Skull bones (except mandible)
  - Are known as intramembranous bones

Endochondral Bones

- Endochondral Bones
  - Bones begin as hyaline cartilage
    - Form models for future bones
  - These are most bones of the skeleton
  - Are known as endochondral bones

Endochondral Ossification

- Hyaline cartilage model
- Primary ossification center
- Secondary ossification centers
- Epiphyseal plate
- Osteoblasts vs. osteoclasts

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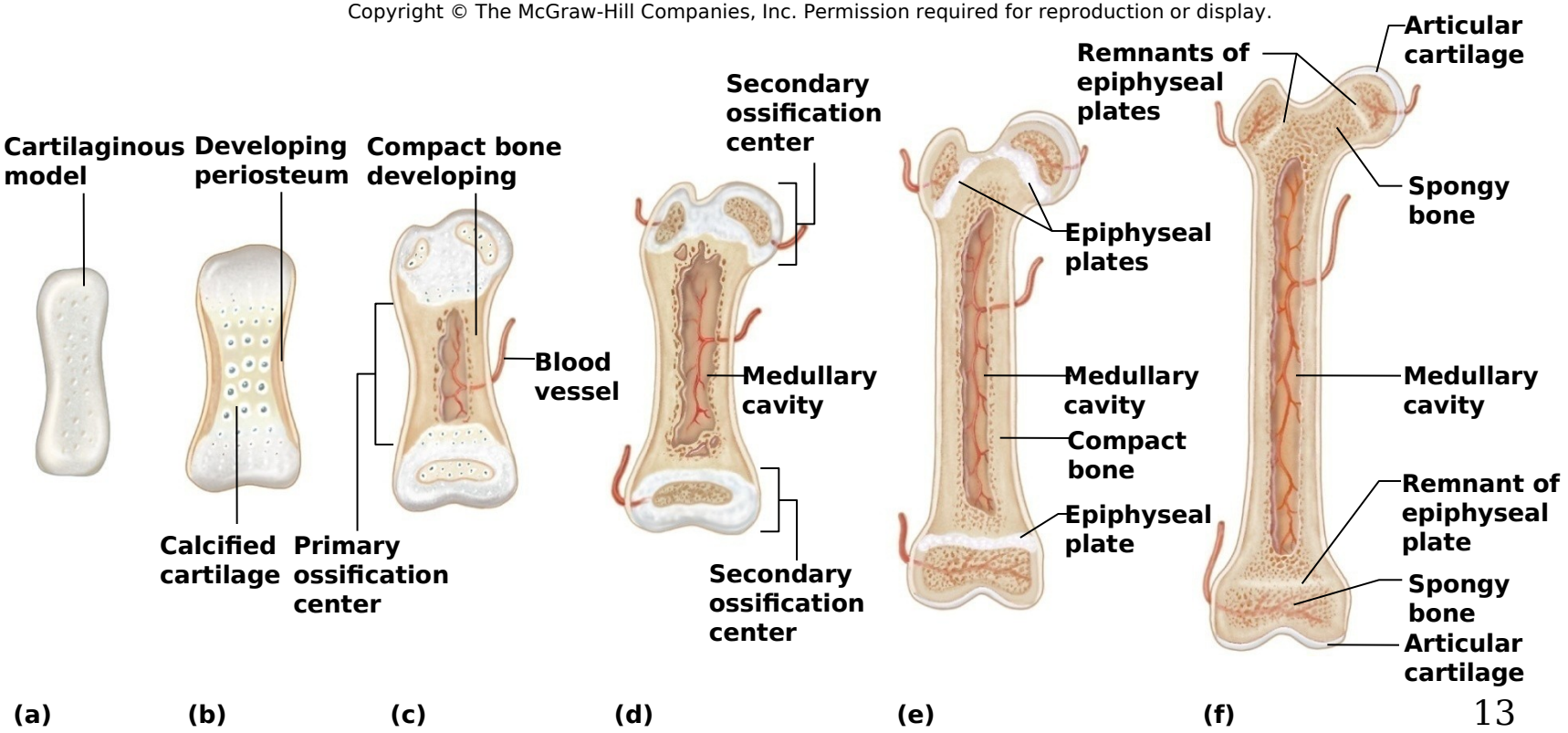

Animation: Bone Growth in Width

Bone Growth in Width
Play
Pause
Audio
Text
Bones grow through the process of appositional growth—the formation of new bone on the surface of older bone or cartilage.
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Growth at the Epiphyseal Plate

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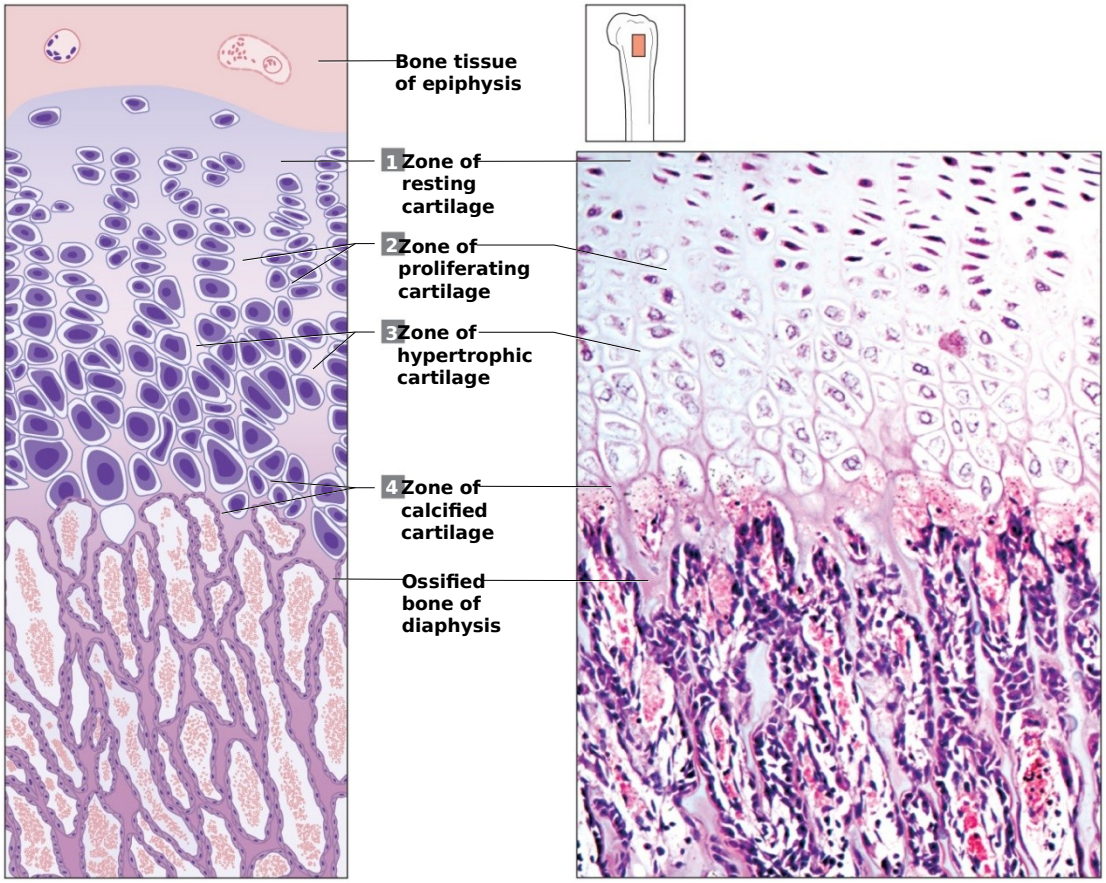
- First layer of cells
  - Closest to the end of epiphysis
  - Resting cells
  - Anchors epiphyseal plate to epiphysis
- Second layer of cells
  - Many rows of young cells
  - Undergoing mitosis



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Growth at the Epiphyseal Plate

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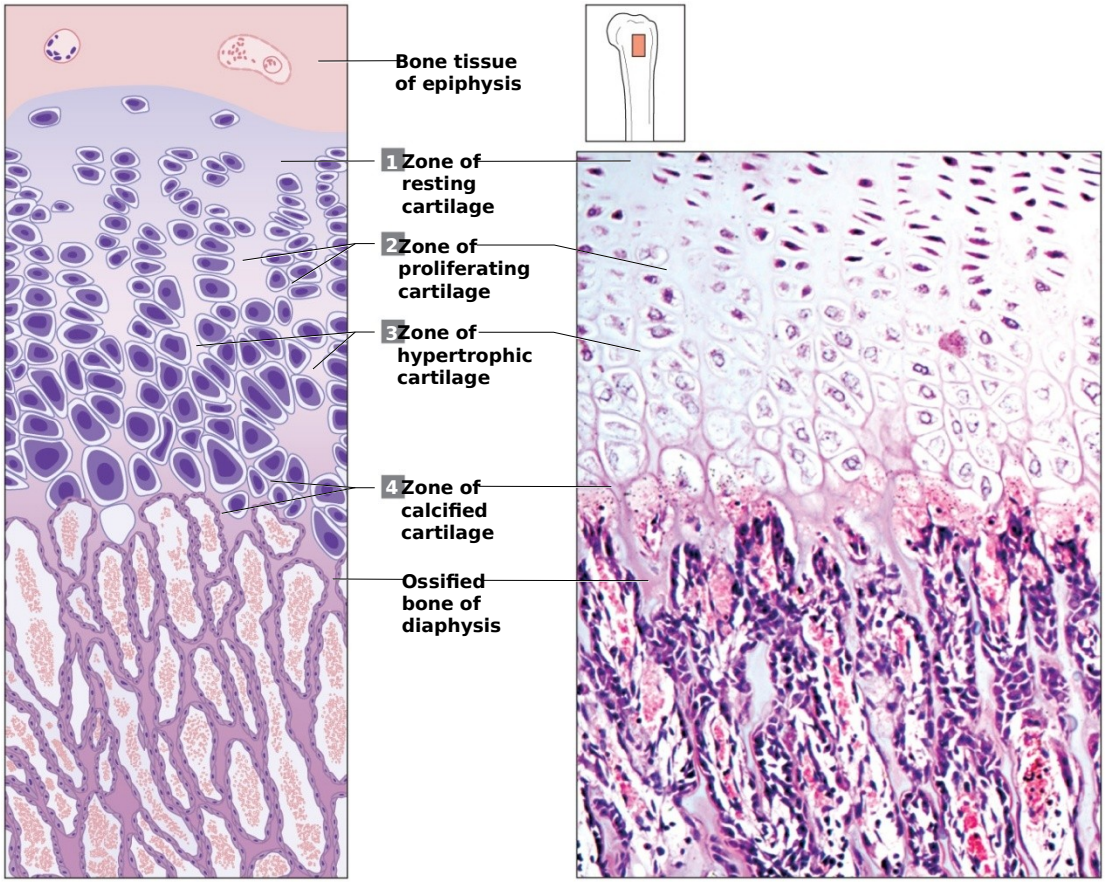
- Third layer of cells
  - Older cells
  - Left behind when new cells appear
  - Cells enlarging and becoming calcified
- Fourth layer of cells
  - Thin
  - Dead cells
  - Calcified extracellular matrix



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Homeostasis of Bone Tissue

- Bone Resorption – action of osteoclasts and parathyroid hormone aka parathormone aka PTH
- Bone Deposition – action of osteoblasts and calcitonin
- Occurs by direction of the thyroid and parathyroi
- Figure 7.

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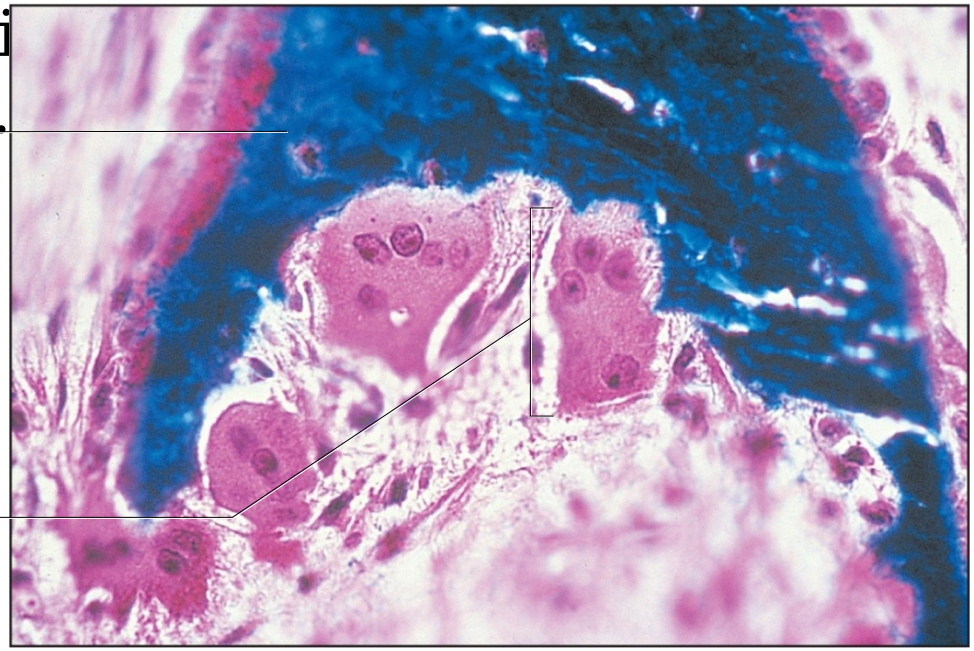

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Factors Affecting Bone Development, Growth and Repair

- Deficiency of Vitamin A – retards bone development
- Deficiency of Vitamin C – results in fragile bones
- Deficiency of Vitamin D – rickets, osteomalacia
- Insufficient Growth Hormone – dwarfism
- Excessive Growth Hormone – gigantism, acromegaly
- Insufficient Thyroid Hormone – delays bone growth
- Sex Hormones – promote bone formation; stimulate ossification of epiphyseal plates

7.1 Clinical Application

Fractures

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Blood Cell Formation

- Blood Cell Formation
  - Also known as hematopoiesis
  - Occurs in the red bone marrow

Inorganic Salt Storage

- Inorganic Salt Storage
  - Calcium
  - Phosphate
  - Magnesium
  - Sodium
  - Potassium

7.2 Clinical Application

Osteopenia and Osteoporosis: Preventing "Fragility Fractures"

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